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APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE:	MOLDED SECTIONED RISER
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MOLDED SECTIONED RISER

BACKGROUND

[0001] 1. Technical Field The present invention relates to subterranean structures, particularly vertical access passages to generally underground facilities, such as septic tanks and pump chambers, the vertical access passages sometimes being referred to as manholes. The present invention particularly to elements used in the construction of the walls of such subterranean structures, which are sometimes referred to as risers. The invention more particularly relates to cylindrical plastic structures made of a plurality of curved segments that are horizontally interlocking and stackable.

[0002] 2. Background Information There has been previous attempts to construct the walls of manholes and other subterranean structures using a plurality of curved segments. In U.S. Patent 4,751,799, a liner segment is formed in a vacuum forming operation from a heated plastic sheet, which is drawn against the surface of a suitably formed mold member to form certain prescribed outwardly extending projections. A plurality of such liner sections are then joined together using simple lap joints and placed within another mold assembly with an optional inner support and with the liner sections being spaced from the mold assembly. Concrete or other casting material is the poured into the space between the liner sections and the mold assembly with the outwardly extending projections of the liner acting to bond the liner to the casting. Other patents disclosing similar liners are U.S. Patents 5,081,802; 5,236,298; 5,303,518; 5,383,311; 5,901,506; and 6,206,609. In all these disclosures, the liner forms a corrosion barrier for the structure, but does not have sufficient strength to constitute the only structural component of the riser.

[0003] Other liner segments are also found, for example, in U.S. Patent 5,608,998, which teaches using liner segments to rehabilitate an existing,

leaking manhole structure. The liner segments are rigid or semi-rigid plastic, and preferably corrugated, panels joined together laterally with an adhesive in a simple lap joint. A plurality of the liner segments are assembled within the existing manhole with a lower edge of each ring including a channel or lip that captures the upper edge of the next lower ring. Once the liner is in place, a bonding layer of polymer foam or other material is injected between the pre-existing manhole structure and the newly formed liner. While the liner has sufficient strength to be self supporting, there is a continuing reliance on the physical strength of the pre-existing leaking manhole to provide some of the structural strength for the structure as a whole.

[0004] One-piece molded plastic structures that are intended for subterranean placement in a variety of fluid containment systems are disclosed in U.S Patents 5,257,652; 5,333,490; 5,361,799; 5,423,447; 5,833,392; 5,988,944; 6,059,208; and 6,189,717. All of the disclosed structures rely substantially entirely on the strength of the plastic materials forming the structures to resist the forces that might be applied by the surrounding soils. Further, it is known to stack structurally self sufficient component formations from U.S. Patents 5,617,679 and 5,852,901. While all these structures use the inherent advantages of the various disclosed polymers and plastics to achieve certain desirable results, all these structures are bulky to transport.

[0005] Underground reinforced plastic enclosures made of a plurality curved segments that are more easily transported are disclosed in U.S. Patents 3,974,599 and 4,089,139. In the earlier disclosure, the curved segments take the form of semi-cylindrical portions having confronting longitudinal edges including outwardly projecting flanges. The flanges are coupled together with bolts and nuts to form the cylindrical members from the semi-cylindrical portions. In the later disclosure, a number of the curved segments, preferably three, are coupled together to form each ring

of the structure. Each of the segments includes vertical side edges that are configured to provide an engaging relationship between the laterally adjacent segments. In particular, one of the vertical side edges is disclosed to include a notch formed by the inner surface of the wall segment and an intersecting inclined wall portion. The other vertical side edge includes a projecting tongue having one surface aligned approximately with the inner surface of the remainder of the wall segment and another surface angled at about the same angle as the intersecting inclined wall portion. The projecting tongue can be seen as a wedge that is adhesively secured in the notch to join adjacent segments together to form a ring, but this amounts to little more than an improved lap joint structure having increased adhesive surface area.

[0006] There remains a need for a reinforced plastic enclosure suited for subterranean use constructed from a plurality of easily transported curved segments that includes vertical side edges having specific structural features that will lock adjacent segments together without a required use of any adhesive or separate fasteners. There is an additional need for a lockable lid that will cooperatively engage a top opening of a subterranean structure defined by the assembled segments. There is a further need for a security device that will inhibit accidental entry into a subterranean structure defined by the assembled segments.

BRIEF SUMMARY

[0007] Accordingly, a subterranean structure of the present invention is formed from a plurality of wall elements in the form of easily transported curved segments. Each curved segment can be viewed as being cylindrically curved about a vertical axis and having an inside surface and an outside surface. Each segment has vertical side edges and horizontal top and bottom edges. A first vertical side edge includes a protruding mating element that is vertically tapered. The second vertical side edge

has a slot that is also vertically tapered. The vertical side edges including confronting surfaces adapted to be brought into abutting relationship in any interlocking engagement between adjacent segments of similar construction. The vertically tapered protruding mating element and slot have surfaces designed to pull the confronting surfaces together as the tapered elements become increasingly mechanically engaged. The protruding mating element can take the form of a dovetail extending continuously along the first vertical side edge with the dovetail including a distal portion having a width of continuously varying dimension to achieve the vertical taper. The corresponding slot on the second vertical side edge is then also dovetailed and of varying width so that vertical relative displacement of two adjacent segments causes the adjacent confronting surface to be drawn together.

[0008] To assemble the curved segments of the present invention into a ring, the protruding mating element of one segment is slipped into the vertically tapered slot of an adjacent segment until the top and bottom edges of the adjacent segments are aligned. The preceding operation is repeated with additional segments until sufficient segments are joined together horizontally to complete a ring except for a last adjacent pair of vertical side edges. The ring is then warped by a distance sufficient to align one end of the protruding mating element of the last adjacent pair of vertical side edges with an opposite end of the adjacent tapered slot. To complete the ring, the aligned protruding mating element and tapered slot are then slipped together while un-warping the joined segments forming the remainder of the ring until the top and bottom edges of all the segments are aligned.

[0009] The rings include a lap portion on either the upper or lower edge so that once some rings are assembled, the rings can be stacked one upon another to form a manhole or other subterranean structure of desired vertical height, the lap portion assuring a self centering of the stacked

rings. The assembly and stacking of the rings to form the subterranean structure can be achieved without tools, adhesives, or separate fasteners. Of course, various fasteners, adhesives or cements can be used with such structures, if desired. Additionally, each of the segments can include features that permit locking engagement with a closure to prevent unauthorized entry into the subterranean structure, and can include various security devices that will inhibit accidental entry into the subterranean structure defined by the assembled segments.

[0010] Other features and advantages of the present invention will become apparent to those skilled in the art from the following discussion of a preferred embodiment illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Figure 1 is a perspective view of a segment of the present invention.

[0012] Figure 2 is a side elevation of two segments of the present invention shown connected together by adjacent vertical side edges.

[0013] Figure 3 is an end elevation view of one of the vertical side edges of a segment of the present invention.

[0014] Figure 4 is an end elevation view of another of the vertical side edges of a segment of the present invention.

[0015] Figure 5 is a plan view of the vertical side edge shown in Figure 3.

[0016] Figure 6 is a plan view of the vertical side edge shown in Figure 4.

[0017] Figure 7 is a plan view of two assembled vertical side edges.

[0018] Figure 8 is a perspective view of the assembly of the last two adjacent vertical side edges to form a ring of the present invention.

[0019] Figure 9 is a schematic end elevation view of a plurality of the segments of the present invention arranged for shipment.

[0020] Figure 10 is a sectional view of a riser constructed using a plurality of rings formed from segments of the present invention.

[0021] Figure 11 is sectional view taken along line 11-11 shown in Figure 10.

[0022] Figure 12 is a sectional view showing the multi-rod latch on a cover engaged with a riser of the present invention.

[0023] Figure 13 is a bottom plan view of the cover shown in Figure 12.

[0024] Figure 14 is a schematic detail view of the locking cam of the cover as shown in Figure 13 with the cam in the locked position.

[0025] Figure 15 is a view similar to Figure 14 with the cam in the un-locked position.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0026] Figure 1 shows a perspective view of a segment 10 of the present invention that is useful to form a riser or other subterranean structure as will be seen from the following discussion. The segment 10 has an outer surface 12 and an inner surface 14. The surfaces 12 and 14 are generally parallel to each other and define a cylindrical wall 16 that is curved around an axis Y at a fixed radius R.. The radius R in one commercial embodiment is about 50 cm, but could be about 80 cm or even more. The outer surface 12 of the segment 10 is shown to include a plurality of horizontal ribs 18 projecting outward from surface 12 that help to maintain the desired curvature of the wall 16. The segment 10 also has a horizontal top edge 20 and a horizontal bottom edge 22. Both edges 20 and 22 are parallel to the horizontal ribs 18 and project outward from the surface 12. The top horizontal edge 20 and the horizontal ribs 18 can be similarly dimensioned so that they project outward from surface 12 by the same amount of distance. The bottom horizontal edge 22 is shown to project outward by a somewhat greater distance than either the top horizontal edge 20 or the horizontal ribs 18. The bottom horizontal edge 22 is also

shown to include a downwardly extending lap portion 23 that can be used to overlap a top feature of an adjacent structure.

[0027] The segment 10 also has vertical side edges 24 and 26, which are discussed in more detail below. The vertical side edges 24 and 26 can be braced by gussets 28 extending between an outer portion of the vertical side edge and the surface 12 of wall 16. The outer surface 12 can also include a plurality of dimples 30 that are designed to act as a centering device facilitating the drilling of a hole in the wall 16 to allow various equipment to be mounted to the wall 16. The inside surface 14 can also include dimples 30 as well as one or more planar regions 31, shown in Figure 10, to facilitate the mounting of equipment such as electrical boxes 33 and the like to the surface 14.

[0028] An adjacent pair of the segments 10 are shown joined together in Figure 2 so that the vertical side edge 24 of one segment is in abutting relationship with the vertical side edge 26 of the other segment along a plane J. The top horizontal edges 20 of both segments 10 are shown to be aligned with each other as are the bottom horizontal edges 22. Further, the top and bottom horizontal edges 20 and 22 are separated by a distance H representing the height of the segments 10. The downwardly extending lap portion 23 extends below the lower margin of the distance H by a much smaller distance h. The distance H in one commercial embodiment is about 23 cm while the much smaller distance h is about 1.1 cm.

[0029] It can be seen from Figure 2 that one of the horizontal ribs 18 is spaced from the bottom horizontal edge 22 by about ½ H while the other horizontal rib 18 is spaced from the bottom horizontal edge 22 by about ¼ H. This spacing of the horizontal ribs 18 can facilitate the horizontal sectioning of the segments 10 immediately above either of the horizontal ribs 18 to form vertically shortened segments that have an upper horizontal edge that is formed by one of the horizontal ribs 18. When so shortened, the horizontal rib 18 forming the upper horizontal edge can interact with a

downwardly extending lap portion 23 of a vertically adjacent bottom horizontal edge 22 to correctly position the vertically adjacent surfaces with respect to each other, which is illustrated in the example shown in Figure 10, discussed below.

[0030] One mechanism for facilitating the junction of the vertical side edges 24 and 26 is shown in Figures 3 to 7. One vertical side edge 24 is shown in Figures 3 and 5 to include a slot 32 that extends into the surface 34 of the side edge 24. The neck portion 36 of the slot 32 that is adjacent to the surface 34 is narrower than the root portion 38 of the slot 32. Additionally the slot 32 is vertically tapered so that the width of the neck portion 36 of the slot adjacent to the upper horizontal edge 20 is narrower than the width of the neck portion 36 adjacent to the lower horizontal edge 22. The other vertical side edge 26 is shown in Figures 4 and 6 to include a protruding mating element 40 projecting from surface 42. The protruding element 40 has a proximal portion 44 adjacent to the surface 42 that is small than distal portion 46. Additionally, the width of the distal portion 46 tapers vertically so that the protruding element 40 is wider adjacent to the bottom horizontal surface 22 and narrower adjacent to the upper horizontal surface 20. The tapered protruding element 40 of vertical side edge 26 is sized and shaped to be received in the tapered slot 32 of vertical side edge 24 as shown in Figure 7.

[0031] The engagement of the tapered protruding element 40 into the tapered slot 32 requires that two adjacent segments 10 be vertically moved relative to each other. While the tapered protruding element 40 and tapered slot 32 are shown in Figures 3-7 to be dove-tailed in configuration, other cross-sectional configurations are possible including circular, ovate, elliptical, etc. Further, while Figures 3-6 show only a single protruding element 40 and a single tapered slot 32, it is also possible that additional protruding elements and tapered slots could be used that are horizontally or vertically related to each other. The slots 32 and protruding elements 40

should be sized in relation to each other so that as the protruding element is increasing received in the taper slot, the surfaces 24 and 42 become increasingly close to each other, and finally come in to complete abutting relationship when the upper horizontal surfaces 20 of the two adjacent segments 10 are coplanar as shown in Figure 2.

[0032] The assembly of a plurality of the curved segments 10 of the present invention into a ring 50 is illustrated in Figure 8. First, the protruding mating element 40 of one segment 10 is slipped into the vertically tapered slot 32 of an adjacent segment 10 until the top and bottom edges 20 and 22 of the adjacent segments are aligned. This operation is repeated with additional segments 10 until sufficient segments, usually 3 are joined together horizontally to complete a ring 50 except for a last adjacent pair of vertical side edges 24 and 26. The segments 10 forming the ring 50 are then warped in the direction of arrows A by a distance sufficient to insert and align the protruding mating element 40 of the last adjacent pair of vertical side edges with the adjacent tapered slot 32. The aligned protruding mating element 40 and tapered slot 32 are then slipped together in the direction of arrows B while un-warping the joined segments 10 forming the remainder of the ring until the top and bottom edges 20 and 22 of all the segments 10 are aligned.

[0033] While Figure 8 shows the ring 50 being warped by a distance nearly sufficient to align the bottom surface 22 of one segment 10 with the top surface 20 of the adjacent segment, it will be appreciated that the warping distance need be only that sufficient to allow the distal end 46 of the protruding element 40 to be slipped through the neck portion 36 of the adjacent slot 32. While a completely satisfactory 50 can be formed and used relying merely on the mechanical connections between the mating elements 32 and 40 of the several adjacent vertical side edges 24 and 26, bonding agents compatible with the polymers forming the segments 10 can

also be used during or after assembly of a complete ring 50 to permanently secure the segments 10 to each other.

[0034] The segments 10 can be made from a wide range of polymers including, without limitation, PVC, DHPP, HDPE and ABS. The polymers desirably have the required properties of strength, stability, impact resistance, and bondable using non-toxic cements that are generally available in the trade. A suitable polymer is, for example, Cycolac® GPX3800 available from GE Plastics. Cycolac® GPX3800 is an ABS plastic having a typical tensile strength of 5400 psi, flexural strength of 9600 psi, and a Izod impact resistance of 8.4 at 73° F.

[0035] The modular design of the riser segments 10 conserves shipping and storage space as shown in Figure 9. Many conventional risers are formed as one piece units represented by the phantom circle 52 having a height D and a width D. By contrast, three of the segments 10 are shown stacked for shipment or storage within a width C and a height E. Where the segments 10 occupy 120° of arc around the ring 50 of the same size as circle 52, the width $C \simeq 0.87D$ and the height $E \simeq 0.35D$. Thus, a stack of segments 10 necessary to construct a ring 50 of the same size as circle 52 occupies less that 40% of the space occupied by the circle 52, which represents substantial savings in storage and shipping costs.

[0036] An access chamber or other subterranean structure 54 can be assembled from a stacked series of rings 50 formed from the segments 10 as shown in Figure 10. The subterranean structure 54 is shown situated on top of a subterranean structure 56 such as a tank or basin that includes an access opening 58 including a ledge 59 surrounded by an upstanding lip 57. A lower most ring 50A is assembled and situated over the opening 58 so that an outer surface 60 of the downwardly extending lap portion 23 is received within the lip 57 to assure centering of the ring 50A with respect to the opening 58. A second ring 50B and a vertically shortened third ring 50C are then stacked on ring 50A. A vertically

shortened segment can be used, of course, at any point in a vertical stack of segmented rings 50.

[0037] With each succeeding ring 50, the downwardly extending lap portion 23 of the upper ring surrounds the junction of the now contiguous horizontal upper and lower surfaces 20 and 22, to assist in centering the rings 50 one on the other, and to deflect moisture away from the horizontal surface junction. Again, a suitable bonding agent can be employed between the abutting surfaces 20 and 22, if desired, but is not necessary to complete a structure of the present invention. A suitable cover plate 62, such as a standard cast iron man hole cover, can be added to restrict access to the subterranean structure 54. The cover plate 62 can be secured to the horizontal upper surface 20 of the uppermost ring 50 by suitable fasteners 63 as are typically used in the trade. Appropriate back fill 66 can be added to surround the rings to aid in stabilization of the manhole 54 with respect to the structure 56.

[0038] Figure 11 is sectional view taken along line 11-11 shown in Figure 10 and shows a bar 68, which can comprise a rung of a ladder, an equipment support or other similar structure, that is mounted in pockets 70 that are formed in the inner wall of the segments 10. A security net 72 can be suspended from a plurality of fasteners 74 that are fixed in holes drilled in selected dimples 30. The security net 72 can comprise a plurality of radial strands 71 and circular or other crossing strands 73, coupled to each other, the strands preferably made of polypropylene rope of sufficient diameter to inhibit accidental entry into the subterranean structure 54 by small animals and children. A preferred diameter is at least about 5mm. The security net 72 can still include small openings 75 of sufficient size to allow access to any tank or basin 56 by a suction hose while inhibiting accidental entry.

[0039] The pockets 70 can also function to receive locking bars of a cover locking mechanism, such as is shown in Figures 12 and 13 that is

intended to restrict entry into the subterranean structure 54 by unauthorized personnel. A locking cover 80 is shown with a key 96 that has a handle 82 fixed to a stem 84, which can be of any length, projecting through a central opening 86 in the cover 80. A lower end of the stem 84 is shown coupled to a cam 88. Proximal ends 91 of a plurality of arms 90 are coupled to the cam 88. The arms 90 extend outward through brackets 92 fixed adjacent to the rim 94 of the cover 80. A distal end 93 of each arm 90 can be moved from a position immediately adjacent to the bracket 92 to a projected position into pocket 70 by rotation of the cam 88 in the direction of arrow A. The distal end 93 of each arm 90 can be withdrawn from the pocket 70 by rotation of the cam 88 in the direction of arrow B, the arms 90 then assuming a position shown in phantom in Figure 13. While Figure 13 shows the presence of three arms 90, the number of arms and their location relative to the lower surface of the cover 80 must be matched to the location of the pockets 70 in the segments 10. When in the locked position, the arms 90 are preferably located in a slightly "over center" position relative to a radius line through the center of the cam 88 so that a prying action on the distal ends 93 of the arms 90 will not cause the cam 88 to rotate to an open position.

[0040] Figures 14 and 15 show the operation of the cam 88 with the key 96 in greater detail. The cam 88 is shown to include a plurality of arcuate openings 83. Fasteners 98 pass through the openings 83 to secure the cam 88 to a lower surface of the cover 80. The fasteners 98 permit the cam to rotate about a central point defined by the arcuate openings 83. The central opening 86 in the locking cover 80 is seen to have an edge 85 defining elongated slot 87. The key 96 is seen to have opposing tabs 97 that are sized to pass through the elongated slots 87 and engage a niche 89 on cam 88. The engagement and disengagement of the key 96 can only occur when the cam 88 is situated in the locked position as shown in Figure 14. When the key 96 is engaged in the

niche 89, and the cam 88 is rotated to the unlocked position as shown in Figure 15, the tabs 97 of the key 96 are trapped by the edge 85 so that the key 96 cannot be removed. This key-trapping feature acts as a reminder to workmen to lock the cover 80 in place to inhibit unauthorized entry.

[0041] While particular embodiments of the invention have been shown and described with reference to the drawings, it is recognized that variations and modifications thereof will occur to those skilled in the art. It is therefore intended that the foregoing detailed description be regarded as illustrative rather than limiting, and that the following claims, including all equivalents, are intended to define the spirit and scope of this invention.